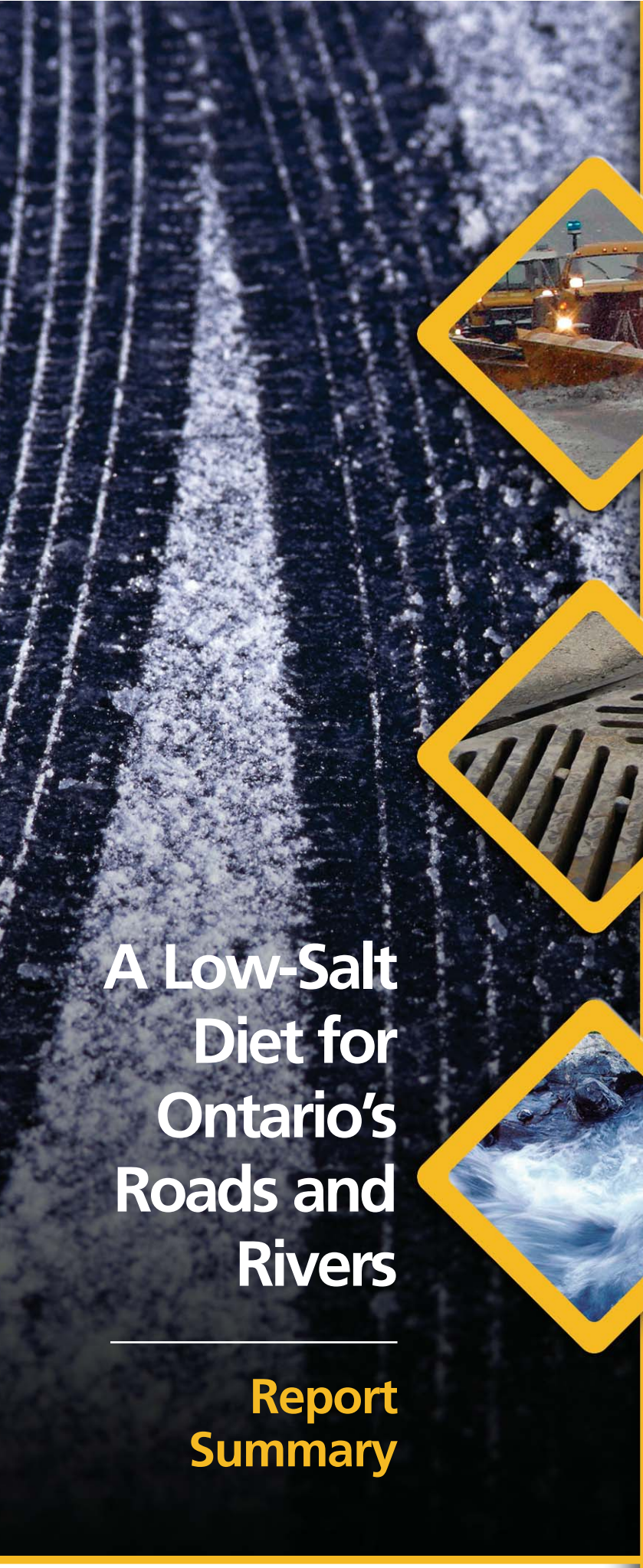

A Low-Salt Diet for Ontario's Roads and Rivers

Report Summary

SIERRA LEGAL DEFENCE FUND

RiverSides™
Where Water Quality Begins

Photo: City of Toronto

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February 2006

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Where Water Quality Begins

Introduction

A Low-Salt Diet for Ontario's Roads and Rivers highlights current regulatory inconsistencies with respect to the use of road salts for winter road maintenance in Ontario. Road salts have been determined to be an environmentally toxic substance under the *Canadian Environmental Protection Act*, 1999 (CEPA). Despite the finding that road salts are environmentally toxic, there are no mandatory requirements for managing road salts storage, application or snow disposal in Ontario.

Of fundamental concern is Ontario's Regulation 339, which exempts road authorities' use of substances that are considered environmentally harmful from the provincial *Environmental Protection Act*. This exemption prevents the Ontario Ministry of the Environment (MOE) from issuing Certificates of Approval with conditions for road salts storage, application and snow disposal. The MOE is also prevented from issuing pollution prevention and abatement orders relating to excessive road salts application.

This report will be used to educate governments and the public about the regulatory inconsistencies that currently exist and offers some recommendations for regulatory reform. Our recommendations are aimed at improving the protection of freshwater ecosystems and drinking water sources, thus achieving a more appropriate balance between ecosystem protection and winter road maintenance. Polling indicates there is strong public support for reforming Ontario's ecosystem protection laws with respect to road salts management.

A Low-Salt Diet for Ontario's Roads and Rivers provides an overview of road salts use in Canada, the current state of regulation and policy, the ecosystem, socio-economic and health implications, and alternative substances for winter road maintenance, all with the intention of informing the debate concerning our over-reliance on road salts. While voluntary road salts management programs exist and legal remedies can be used to redress the harm caused by road salts, there is currently no comprehensive road salts management regime to provide an appropriate balance between ecosystem protection and winter road maintenance in the public interest.

This report forms the basis of an Application for Review under Ontario's *Environmental Bill of Rights*, 1993. This Application will request that Regulation 339 be immediately revoked and, in its place, a phased-in road salts management regime under the *Environmental Protection Act* be implemented. Recommendations are also offered regarding Bill 43 (the proposed *Clean Water Act*), and mandatory reductions in speed limits during winter conditions and mandatory requirements for snow tires under the *Highway Traffic Act*, all of which support a new road salts management regime.

Finally, *A Low-Salt Diet for Ontario's Roads and Rivers* offers specific recommendations to the federal government that will provide national and international support for mandatory regulation of road salts across Canada, and specifically within the Great Lakes Ecosystem Basin.

This report is a summary document. For complete details and references please refer to A *Low-Salt Diet for Ontario's Roads and Rivers* (RiverSides and Sierra Legal, 2006), available on CD or at *www.riversides.org* or *www.sierralegal.org*.

Road Salts Use in Canada

The term "road salts" generally refers to the four common chloride salts used as deicers in Canada: sodium chloride (NaCl), calcium chloride (CaCl), magnesium chloride (MgCl) and potassium chloride (KCl), along with an anti-clumping agent, ferrocyanide salt.

Road salts work by lowering the freezing point of water. When snow or ice accumulates it forms a bond with the surface of a roadway or sidewalk. Road salts dissolve in the available water in snow or ice to form brine. The brine breaks the bond of ice or snow to the surface of the roadway by lowering the freezing temperature.

Road salts came into common use in the 1940s as a melting agent for removing ice and snow. Driven by growing urbanization and increasing density of road networks, as well as changes in service levels requiring more "bare pavement" policies on roadways, total road salts usage and application rates have been on the rise in Canada since the 1970s.

The federal government has estimated that almost 5 million tonnes of road salts were used on Canadian roadways in 1997/98—approximately 165 kilograms of road salts per Canadian. Since that time, the total amount of road salts used has continued to rise, with an estimated 6.8 million tonnes of road salts sold for highway deicing in Canada in 2003.

Sodium chloride is by far the most predominant road salt in use, with more than 4.7 million tonnes used in 1997/98. Quantities of the other types of road salts used during that period included 107,992 tonnes of calcium chloride, more than 25,000 tonnes of magnesium chloride and 2000 tonnes of potassium chloride.

Current Regulation and Policy

Within Ontario, ecosystem protection is controlled through various legislations, statutes, regulations, municipal by-laws, and government policies. At present, the use and storage of road salts and snow disposal are not directly controlled through any specific statute or by-law. And, although there are several pieces of legislation that deal with protecting ecosystems and water quality, there are currently no provincial or federal regulations that govern road salts use or road salts concentrations in the ecosystem. Furthermore, although some statutory and common law remedies can be used to prevent or compensate for harm associated with road salts, there is no comprehensive road salts management regime that provides an appropriate balance between winter road maintenance and ecosystem protection in the public interest.

Ontario's Environmental Protection Act

The *Environmental Protection Act* (EPA)—Classes of Contaminants—Exemptions, R.R.O. 1990, Regulation 339 specifically, exempts "any substance" that is a contaminant and used by a road authority "for the purpose of keeping the highway safe for traffic under the conditions of snow or ice or both" from the EPA and associated regulations.

The exemption prevents the Ministry of the Environment (MOE) from issuing Certificates of Approval with conditions for road salts storage, application and snow disposal. The MOE is also prevented from issuing pollution prevention and/or abatement orders relating to excessive road salts application. Regulation 339 was initially made in 1972, the year after the *Environmental Protection Act*, 1971 (EPA) was first enacted. While there have been several significant amendments to the EPA since then, Regulation 339 has never been altered from its original form.

The MOE also has policy guidelines regarding snow disposal and deicing operations. These voluntary guidelines set out criteria for activities including the storage and application of road salts. However, the MOE has indicated that it does not allocate any money or resources to monitor compliance with these guidelines.

Ontario's Bill 43—Clean Water Act

In December 2005, the Ontario government introduced Bill 43, the *Clean Water Act*. Bill 43 outlines a watershed-based plan for protecting Ontario's drinking water resources. It mandates that source protection plans be set up in watersheds throughout the province in order to identify current and potential threats to key water resources and to prohibit or regulate potentially harmful activities. Once a source protection plan is in place, all land-use planning and government activities must conform to the plan. It may be possible under Bill 43 for the Ontario government to designate activities such as the application of road salts as a significant threat to drinking water. This will be particularly important in areas where the sole drinking water source is groundwater. Bill 43 also provides that when there is a conflict between provisions of the proposed *Clean Water Act* and the provisions of any other Act or regulation, the provision that provides for the greatest protection of water quality or quantity will prevail. However, the impact of this proposed drinking water source protection planning will not be realized for some time, even if Bill 43 becomes law in Ontario this year.

Canadian Environmental Protection Act, 1999

Under the *Canadian Environmental Protection Act*, 1999, S.C. 1999, c.33 (CEPA) the Government of Canada is required to, among other things, "take preventive and remedial measures to protect, enhance and restore the environment" and "protect the environment, including its biological diversity, and human health, from the risk of any adverse effects of the use and release of toxic substances, pollutants and wastes". Initiated under an earlier version of the Act, there is an ongoing assessment and management of priority substances. In 1995, road salts were determined to be a priority substance. As a result, a five-year scientific assessment was carried out to examine and document the effects road salts were having on the ecosystem. In 2001, the Priority Substances List Assessment Report for Road Salts (Assessment Report for Road Salts) was released, indicating that road salts are "toxic" as defined under CEPA. At the time, the Ministers of the Environment and Health recommended that road salts be added to the List of Toxic Substances in Schedule 1 under CEPA; however, to date, road salts have not been officially listed. As a result of this recommendation, Environment Canada convened a multi-stakeholder process which developed a Code of Practice for the Environmental Management of Road Salts (Code of Practice), released in April 2004. The Code of Practice is a voluntary pollution control instrument for road authorities using more than 500 tonnes of road salts per year, or that apply road salts in areas determined to be vulnerable ecosystems.

Road Salts: The Weight of Evidence

Road salts are released into the ecosystem primarily through their application onto roadways. They also enter the environment through inappropriate storage methods and housekeeping techniques, as well as in the disposal of huge quantities of salt-laden snow. All road salts eventually dissolve into surface water and groundwater, unless they become attached to soils and plant material.

Road salts are made of chloride ions (Cl^-) and an associated cation—the predominant sodium (Na^+); or calcium (Ca^{2+}), magnesium (Mg^{2+}) or potassium (K^+). Chloride ions are relatively stable, meaning that they can move through the environment in solution without being lost or broken down through natural processes. As such, almost all chloride ions that enter the environment reach surface water.

Chloride is naturally present in the environment. Background levels of chloride concentrations in Ontario's surface water ranges between 1 and 30 milligrams per litre (mg/L). However, runoff from roadways, salt storage yards and snow disposal sites result in greatly elevated chloride levels in surface water, soil and groundwater as shown in Table 1.

Table 1. Observed Chloride Concentrations in Canada

Source	Peak Chloride Concentration
Normal freshwater	20–50 mg/L
Urban streams in winter	over 1000 mg/L
Groundwater	2800 mg/L
Snow cleared from roadways	3000–5000 mg/L
Highway runoff	over 18,000 mg/L
Ocean water	25,000–30,000 mg/L
Salt storage area runoff	82,000 mg/L

Adapted from Tom Schueler, Center for Watershed Protection, Snow, Road Salt and the Chesapeake Bay (2005) with data from Environment Canada and Health Canada (2001).

The Ontario Provincial Water Quality Monitoring Network has compared water quality data collected at sites across the Lake Ontario drainage basin from 1980–82 with data collected from 1996–98. Over this 16-year period, 71 percent of sites showed increasing trends for chloride concentrations. The study related this increasing trend with the increasing urbanization and development that has occurred in these watersheds since the 1980s.

Summary of Ecosystem Impacts

Various studies have documented that both aquatic and terrestrial ecosystems can be adversely affected by exposure to chloride concentrations associated with the typical use of road salts. In water bodies, elevated chloride levels have been demonstrated to be lethal to many aquatic species. It is also estimated that 10 percent of aquatic species will be adversely affected by prolonged exposure to chloride concentrations greater than 240 mg/L, and 5 percent would be adversely affected by exposure to concentrations of about 210 mg/L. Increasing salt concentrations can also lead to dramatic changes in the vertical mixing and oxygen levels.

Damage to vegetation is perhaps the most visible sign of road salts' effect on terrestrial ecosystems. Salts inhibit the absorption of water and nutrients by plants and can be directly toxic to plant cells. High salt concentrations also lead to degradation of the physical and chemical properties of soil and can adversely affect micro-organisms and other soil organisms.

Road salts have been found to have direct toxicological effects on terrestrial wildlife, mainly mammals and birds. Large mammals, such as moose, deer and elk, are attracted to roadside salt pools, which have long been identified as a major factor contributing to collisions with motor vehicles. Bird kills, some involving hundreds of birds, have been associated with road salts poisoning. In addition, ingestion of road salts has been found to diminish the ability of birds to avoid moving vehicles.

Economic and Ecological Costs

Road salts continue to be used intensively because they are perceived to be the cheapest and most effective solution to winter transportation issues. The benefits of road salts use are considerable; they facilitate safer and more accessible roads and efficient transport of people and goods in winter conditions. However, these benefits diminish when compared with the full ecological and economic costs of road salts use, including the degradation of water bodies and ecosystem biodiversity, and the corrosion of built infrastructure, such as roads and bridges, and motor vehicles.

It is estimated that US$5 billion dollars is spent annually by state and local agencies to repair infrastructure damage caused by snow and ice control operations—equivalent to $333 per ton of road salts used. It has been calculated that indirect costs caused by traffic delays and lost productivity are more than 10 times the direct cost of corrosion maintenance, repair and rehabilitation. The same corrosive effects and costs are also experienced with other road-related infrastructure including parking garages, sidewalks, light standards, advertising billboards and buildings adjacent to road ways.

Health Implications

One of the major health implications of road salts is the threat posed to drinking water sources. Although road salts were not recognized as having a significant direct impact on human health in the Assessment Report for Road Salts, the loss of access to clean drinking water is a significant health impact. The drinking water chemical and physical objectives and guidelines for chloride (250 mg/L) and sodium (200 mg/L) are considered aesthetic objectives. However, the Ontario Drinking Water Technical Guidelines also suggest that a much lower

standard for sodium (20 mg/L) should trigger notification of the local Medical Officer of Health so that physicians can be informed in order to deal with sodium restricted diets. The US Public Health service also recommends much lower limits, generally 25 mg/L of chloride.

A Low-Salt Diet

Reducing the ecosystem impacts of road salts in Ontario requires a comprehensive and integrated approach. This approach includes implementing best management practices concerning storage and application, reducing the amount of salt through improved application techniques, integrating alternative products into current practices, and introducing policies to achieve social change.

Best Management Practices

Environment Canada's Code of Practice recommends the voluntary development of salt management plans to implement best management practices (BMPs) by road authorities using more than 500 tonnes of road salts annually, or applying salt in environmentally vulnerable areas. These BMPs focus on three areas: storage, application and snow disposal.

Storage sites have historically been a large source of chloride contamination through runoff. The BMPs are thus designed to eliminate this source of contamination on both existing and new storage sites.

BMPs for **application** are designed to minimize the amounts of salt used by targeting delivery based on specific conditions in specific places. This targeting includes using calibrated spreaders to ensure even distribution of the salt and determining when to salt, and how much salt to apply through the use of road weather information systems, infrared thermometers and road surface friction sensors. Perhaps the most important improvement in road salts application came with the introduction of pre-wetting and anti-icing techniques. Pre-wetting is the practice of using a liquid to wet salt prior to spreading. This technique improves the ability of the salt to stick to the surface of the roadway and enables it to melt ice quicker. Anti-icing involves spreading salts prior to the storm event, which prevents ice from forming and assists in the rapid melting of snow and ice.

In many urban centres, snow is removed to a **snow disposal** site—or snow dump. By depositing snow in one location, road authorities are concentrating the potential contaminants, including road salts, oil, grease and heavy metals. Therefore BMPs include taking precautions to ensure that snow dumps are not located near environmentally sensitive areas and are able to contain and treat runoff as necessary.

Implementing BMPs has the potential to greatly reduce the amount of road salt loadings to the ecosystem. However, participation is completely voluntary and any salt management plans developed under the Code of Practice are not reviewed or approved by Environment Canada.

Alternative Products

A tremendous amount of research has been dedicated to exploring alternative deicing products that have less ecological and economic impact than traditional road salts. Non-chloride based alternatives include acetate and formate products.

Calcium magnesium acetate (CMA) is the most widely studied alternative to road salts. Its effectiveness is in the same range as sodium chloride, decreasing below -7°C. CMA does not directly melt ice or snow, but breaks the bond between snow particles and the road surface enabling it to be ploughed more efficiently. As such, CMA is not a good deicer on its own, but is an effective anti-icer when applied ahead of an event. CMA contains no chlorides and is biodegradable.
It is also less corrosive than chlorides and demonstrates low toxicity in aquatic environments, but may deplete oxygen in some aquatic habitats. CMA is ideal for areas such as bridges or parking decks that are vulnerable to corrosion, and for roadways in environmentally sensitive areas. The initial cost of CMA is significantly higher than that of road salts.

Liquid **potassium acetate** can be used as an anti-icer, deicer, or as a pre-wetting agent. It is chloride-free, biodegradable, non-corrosive and has a low toxicity. It is effective at temperatures lower than -26°C. It is an ideal alternative for use in vulnerable areas, where environmental damage or corrosion is a key concern. Liquid potassium acetate is particularly well-suited for FAST-systems (fixed automatic spray technology systems) that are used on bridges, exit ramps and other elevated structures.

Sodium acetate is used in solid or liquid form, primarily as a deicer and anti-icer on airport runways. As with other acetate products, sodium acetate is chloride-free, biodegradable, with low toxicity. It is considered an environmentally friendly alternative to urea, which has been a common airport deicer.

Both **sodium formate** and **potassium formate** have been primarily used as airport runway deicers, however, recent studies show promise for the increased use of potassium formate as a highway deicer. Potassium formate biodegrades rapidly and is less harmful to groundwater than traditional road salts applications.

Policy Change for Safer Roads

As discussed, road authorities have the ability to dramatically reduce the amount of road salts entering the ecosystem by implementing salt management plans that incorporate BMPs. These efforts can be complemented and enhanced through provincial government educational and regulatory programs. By altering public demand for winter road maintenance, changes in the necessity for bare pavement policies and reduced road salts demand should result. Two societal factors are highlighted: mandatory snow tire installations on automobiles, and winter speed limits.

Due to the current popularity of all-season radial tires, it is estimated that only a minority of Ontario drivers use winter tires. The reduced use of winter tires is part of the reason road authorities maintain “bare pavement” objectives. Research demonstrates that reduced winter speed limits and increased winter tire use will reduce the incidence of accidents on winter roads, which will then reduce the need for reliance on road salts alone to achieve the goal of winter road safety.

Conclusion and Recommendations

The overall goal of A *Low-Salt Diet for Ontario's Roads and Rivers* is to encourage law reform in Ontario in order to prevent chronic damage to the ecosystem and built infrastructure from road salts storage, application and snow disposal activities. To this end, this report presents six recommendations. Each recommendation is aimed at improving the regulatory and policy framework regarding road salts management and ultimately ensuring that the full costs associated with road salts use are being taken into account in order to achieve the appropriate balance between ecosystem protection and winter road maintenance.

Province of Ontario

Recommendation 1: That the *Environmental Protection Act*, Classes of Contaminants—Exemptions, R.R.O. 1990, Regulation 339 be immediately revoked.

Recommendation 2: That the Ontario Ministry of the Environment immediately implement a phased-in mandatory road salts management regime requiring all road authorities to seek a Certificate of Approval under the *Environmental Protection Act* for road salts storage, application or snow disposal in Ontario.

Recommendation 3: That Ontario's Bill 43 (the proposed *Clean Water Act*) require that all drinking water source protection plans address the issue of road salts, regardless of the threat assessment on current and potential drinking water sources, until such time as the permit system can be implemented.

Recommendation 4: That the Ontario government institute an educational and regulatory program to reduce the incidence of accidents on winter roads. Specifically, we recommend mandatory reductions in speed limits during winter conditions and mandatory requirements for snow tires under the *Highway Traffic Act*.

Federal Government

Recommendation 5: That road salts be immediately listed on Schedule 1 under the *Canadian Environmental Protection Act, 1999*.

Recommendation 6: That the federal government pursue changes to the Great Lakes Water Quality Agreement that would require proper management of road salts use throughout the Great Lakes Basin ecosystem.

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RiverSides Stewardship Alliance

RiverSides is a non-profit organization dedicated to preventing runoff pollution for the protection, preservation and restoration of rivers.

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